IAF SPACE POWER SYMPOSIUM (C3)
Interactive Presentations - IAF SPACE POWER SYMPOSIUM (IP)

Author: Mr. Jose Antonio Fernandez Alvarez
Universidad de Oviedo, Spain

Dr. Pablo Fernandez
Universidad de Oviedo, Spain
Prof. Manuel Arias
Universidad de Oviedo, Spain
Prof. Fermin Navarro-Medina
University of Vigo, Spain
Prof. Carlos Ulloa
University of Vigo, Spain
Mr. Manuel Diz-Folgar
University of Vigo, Spain
Mr. Alejandro Camanzo-Mariño
Universidad de Vigo, Spain
Dr. Alejandro Gomez-San-Juan
Universidad de Vigo, Spain
Mr. Ramy Mesalam
University of Leicester, United Kingdom
Mr. Ovidiu Faur
European Space Agency (ESA-ESTEC), The Netherlands
Mr. Miguel Fernández Costales
Universidad de Oviedo, Spain

STUDY OF ARCHITECTURES FOR RTG-SOLAR HYBRID POWER SUBSYSTEMS IN SPACE VEHICLES.

Abstract

The combined use of Radioisotope Thermoelectric Generators (RTGs) alongside Solar Arrays (SAs) and batteries is a promising strategy for ensuring a reliable and sustainable power supply for space missions. While SAs harness sunlight when available, RTGs provide a continuous source of power in situations where sunlight is limited or inadequate. A battery provides for the times that the transient power demands exceed the combined SA and RTG generation. This combination offers a versatile and robust solution for the energy needs of space missions, ensuring optimal operation in a variety of conditions and locations within the solar system. An efficient design, in terms of available power and mass, of the Electrical Power Subsystem (EPS) is mandatory for the success of the mission. The different power sources must be properly managed so most of the power is available for the loads whilst keeping the sources at their most convenient operating conditions.

Different architectures can be used whether they are based on a power bus voltage-regulated or on a power bus whose voltage is directly defined by one of the power sources. Regarding the RTG, one of the main concerns is adapting its low output voltage to the bus voltage. This can be done in several ways. For instance, by serializing several RTGs (efficient but introduces reliability concerns), using DC/DC

conversion technologies (straightforward but increases power losses), or using partial processing techniques (reduces power loss but increases complexity).

This study is to analyse each architecture to see their benefits and disadvantages and assess them qualitatively and quantitatively. Every proposed architecture is evaluated by sizing each power source and the units used to regulate them, according to different mission requirements. Then the mass and the electrical power available to the loads is computed. For that purpose, models of each component (SAs, RTGs, batteries, DC/DC converters) are used to evaluate every scenario. The results obtained on this study, are represented in a series of figures of merit, related with the mass of the power sources, the efficiency of the regulators used, the energy dissipation in terms of temperature (which can affect to the RTG behaviour), the maximum operation time and the battery time recharge.